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Seasonal Variation in Avian Fauna of Sarsuna Satellite Township Area – A Case Study

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Abstract- Birds are considered as one of the most significant indicators of the environment. Because they are very much sensitive to habitat change. Changes in bird populations are an important indication of environmental problems. During the time of urbanization, the population of birds has been particularly affected mainly in urban and suburban areas. The area of our study – Sarsuna Satellite Township is mainly a suburban region where the bird population is also likely to be affected. However, our study mainly focuses on the analysis of these bird populations and to compare their diversity indices in pre and post monsoon season. The study reveals a wide range of birds according to their feeding habits and their family. A comparative study summarizes that there is no significant difference in bird diversity between two seasons but however the total bird count irrespective of the seasons are alarmingly low and therefore need special attention.

Keywords- Sarsuna Satellite Township Area, Avian fauna, Seasonal Variance, Diversity Indices.

I. INTRODUCTION

Urban ecosystem services are specifically defined as services that are being provided by urban ecosystems and their components. Ecosystems and their services are critical for sustenance of life in urban settlements, maintenance of health, amicable socio-economic relationships, social and other factors. Urban ecosystems are those where people live in high densities or those where the built infrastructure covers a large proportion of the land [7]. The infrastructures in these areas incorporate both planted vegetation such as parks and gardens and water bodies like ponds, small lakes and wetlands [2]. In other words, areas around the main cities anyhow linked to or directly managed and affected by urban or suburban parts are also components of urban ecosystems. With the increasing impact of urbanization in the natural ecosystems, urban areas have a key role in the preservation and enhancement of biodiversity [3]. While many floral and faunal species can colonize cities, their survival in urban environments is often challenging, as shown by local extinctions and failures in population establishment. Most current understanding of bird communities in cities or urban areas have come from disparate analyses of single cities [4] over relatively short time periods, producing limited understanding of processes and characteristics of bird diversity in those areas. Here we analysed bird biodiversity [11] in the Sarsuna Satellite Township (also known as Shakuntala Park Housing Estate). It is a township located in South Kolkata, and forms part of the greater Behala region in the Indian state of West Bengal. This Township is twelve kilometres from Raj Bhavan or Esplanade, Kolkata, West Bengal, India (Central Kolkata) [17]. This Township is under Kolkata Municipal Corporation area with Ward no – 127. In this study we analyse different diversity indices on the basis of observation of avian fauna found in the area, by which we can explain the species richness, species abundance, species evenness and species dominance of our study area. Those data have reflected the total diversity of avian fauna of the Sarsuna Satellite Township area.

II. MATERIALS AND METHODOLOGY

Study site

Sarsuna Satellite Township is reachable through Diamond Harbour Road. After Behala Chowrasta, then take a right turn through Ho Chi Minh Sarani (Formally known as Biren Roy Road –west). The distance between Behala Chowrasta to this township area is about 2.5 kilometres and it is well communicable. It starts two kilometres from Behala Chowrasta (2nd phase of Township) and extends to another one and a half kilometres or more till end of 1st phase of the Township. The township mainly consists of middle-class service people of different groups like higher income group, middle Income group, lower Income group and economically weaker group. The area is under the jurisdiction of Thakurpukur Police Station which is a part of the South Zone of the Kolkata Police Department. The township also consists of Shakuntala Park Police outpost.

Figure 1. Satellite view of Sarsuna Satellite Township area.

Three lakes (Lake No- 1, 2 and 3) are within the Township area. Lake-1 is maintained by Kolkata Corporation with a park and walking path all around, although the other lakes are not maintained and are used as fishery.

A playground, named Central Park with a swimming pool located beside lake-1. It is under the supervision of Kolkata Corporation. Two colleges - Sarsuna College and Sarsuna Law College, are located in the study area. At the southern part, there is a supermarket area.

Total study area is about 3361917 Square meter. Many large trees like banyan, mango, coconut, jackfruit, Indian rosewood, eucalyptus, etc., many shrubs like lemon, tulsi, rose, china rose, jasmine etc. are found here.

1) Bird survey methods [1]

Bird data were collected in checklist format by total observation of three hours in the specific study days, whereby birds are seen or heard at a given survey location, over pre - monsoon and post – monsoon. We also analysed the different parameters of water found in the Sarsuna lake area.

Study of different diversity indices:

All collected data are analysed by using different biodiversity indices in pre - monsoon and post - monsoon way to know the species richness, density, evenness

A 'species diversity index' is the ratio between the number of species and other important values of individuals. It is a mathematical measure of species diversity in a community providing important information about rarity and commonness of species and also takes the relative abundances of different species in a particular community.

Menhinick's Species Richness Index [13]

Species richness is a measure of the number of species found in a sample. When the sample is large, the more species we would expect to find, the number of species is divided by the square root of the number of individuals in the sample and this is known as Menhinick's index. The index is denoted by 'D'.

Formula

$$D = \frac{S}{\sqrt{N}}$$

Where,

D = Menhinick's Diversity Index
S = Number of Species Recorded
N = Total Number of Individuals in the Sample

Significance

- The cumulative species richness can be known from this index.
- This index is also used for aiding the interpretation of species availability within the different groups.
- It is also used to compare samples of different sizes and the effect of the number of individuals is reduced.

Margalef's Species Richness Index [13]

It is a count of the number of different species in a given area or community. The measure is strongly dependent on sampling size and effort. A simple measurement of species richness by expressing the simple ratio between total number of individuals of species and total number of types of species to calculate the species richness, which is denoted by 'M' is called Margalef's index.

Formula

$$M = \frac{(S-1)}{\ln N}$$

Where,

M = Margalef's Diversity Index
S = Total Number of Species
N = Total Number of individuals in the Sample

Significance

- The simplest measure of biodiversity richness is simply a count of the number of different species in a given area.
- This index can be used to compare one community or group of populations with another provided one.

Dominance Diversity Index [13]

A community dominated by one or two species is referred to as less diverse than one in which several different species have a similar abundance. Dominance Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each Species. The diversity increases with the increase of species richness and species evenness. This index is called the 'Dominance Diversity Index', denoted by 'C'.

Formula

$$C = \frac{N_{max}}{N}$$

Where,

C = Dominance Diversity Index
N_{max}= Number of Individuals in the most abundant species
N = Total Number of Individuals in the Sample

Significance

- It is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species.
- This index is a measure of diversity which takes into accounts both richness and evenness.

Shannon Wiener Index [16]

The Shannon Wiener Index is a widely used information statistic index for comparing diversity between various habitats, which means it assumes all species are represented in a sample and that they are randomly sampled. This is a dominance index because it gives more weight to common or dominant species.

Formula

$$H' = -\sum(\frac{n_i}{N})ln(\frac{n_i}{N})$$

or, $P_i = (\frac{n_i}{N})$

or, $H' = -\sum(P_i)(ln\, P_i)$

Where,

H' = Shannon Weiner Index

n_i = Number of individuals of species i

N = Total number of individuals of all species

P_i = Importance probability for each species

Significance

- This index value indicates the species richness and species evenness.
- The equation is here written with natural logarithms, the base of the logarithm used when calculating the entropy.
- These indices and statistics are used to summarize the diversity of a population in which each member belongs to a unique group.

Pielou's Species Evenness Index [14]

Species evenness refers to how close in numbers each species in an environment is. It is defined as a diversity index, which helps to measure the diversity with species richness.

Formula:

$$e = \frac{H'}{ln\, S}$$

Where,

e = Evenness Index

H' = Shannon Index

S = Total number of species

Significance:

- Equitability in the community of individuals can be expressed by an index.
- Species Evenness Index indicates the functional relationship between various tropic levels [6].

Devices used

Canon EOS 1200D camera with 55mm-250mm lens, Olympus binocular and cell phones have been used for the purpose of observation and photographic documentation purposes.

Duration of the work

- Pre - monsoon study dates: - 24/06/2019, 14/07/2019, 28/07/2019
- Post - monsoon study dates: - 31/10/2019, 27/11/2019, 18/12/2019

Timing

7.00 AM -10.00 AM on every study date[21].

III. RESULT AND DISCUSSION

Table 1. Generalized checklist of avian fauna recorded from the study site: [5]

Serial no.	Common name	Scientific name	Family
01	House Crow	*Corvus splendens*	Corvidae
02	House Sparrow	*Passer domesticus*	Passeridae
03	Common Myna	*Acridotheres tristis*	Sturnidae
04	Asian Pied Starling	*Gracupia contra*	Sturnidae
05	Red Whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae
06	Red Vented Bulbul	*Pycnonotus cafer*	Pycnonotidae
07	Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae
08	Common Tailor Bird	*Orthotomus sutorius*	Cisticolidae
09	Purple Sunbird	*Cinnyris asiaticus*	Nectariniidae
10	Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae
11	Black Drongo	*Dicrurus macrocercus*	Dicruridae
12	Yellow-footed Green Pigeon	*Treron phoenicopterus*	Columbidae
13	Spotted Dove	*Stigmatopella chinensis*	Columbidae
14	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae
15	Asian Openbill Stork	*Anastomus oscitans*	Ciconiidae
16	Indian Pond Heron	*Ardeola grayii*	Ardeidae
17	Black Kite	*Milvus migrans*	Accipitridae
18	White-breasted Waterhen	*Amaurornis phoenicurcus*	Rallidae
19	Greater Coucal	*Centropus sinensis*	Cuculidae
20	Green Bee-eater	*Merops orientalis*	Meropidae
21	Lesser Golden back woodpecker	*Dinopium benghalense*	Picidae
22	White Wagtail	*Motacilla alba*	Motacillidae
23	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae
24	Cattle Egret	*Bubulcus ibis*	Ardeidae

25	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae
26	Rufous Treepie	*Dendrocitta vagabunda*	Corvidae
27	Little Swift	*Apus affinis*	Apodidae
28	Coppersmith Barbet	*Megalaima haemacephala*	Ramphastidae
29	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae
30	Jungle Myna	*Acridotheres fuscus*	Sturnidae

Table 2. Seasonal findings of avian fauna of pre - monsoon data [5]

SL. NO	NAME OF BIRDS	NO. OF BIRDS OBSERVED			
		DAY-1	DAY-2	DAY-3	TOTAL
1	House crow	8	7	9	24
2	House sparrow	4	3	2	9
3	Common myna	8	9	6	23
4	Asian pied starling	2	1	2	5
5	Red whiskered bulbul	0	2	1	3
6	Oriental magpie robin	2	3	1	6
7	Common tailor bird	0	0	2	2
8	Purple sunbird	0	1	1	2
9	Black drongo	2	1	1	4
10	Yellow-footed green pigeon	4	6	5	15
11	Spotted dove	3	2	3	8
12	Asian open bill stork	1	2	2	5
13	Indian pond heron	8	2	2	12
14	Black kite	4	1	2	7
15	Cattle egret	2	1	2	5
16	White breasted water hen	2	0	2	4
17	Greater coucal	1	0	0	1
18	Green bee eater	1	1	2	4
19	Lesser goldenback woodpecker	0	1	0	1
20	Little cormorant	3	2	3	8
21	Bronze winged jacana	1	0	2	3
22	Rufous treepie	1	0	0	1
23	Coppersmith barbet	1	0	0	1
24	White-throated kingfisher	1	0	2	3
25	Rose-ringed parakeet	1	2	1	4

Table 3. Classification of observed birds according to family found in Pre monsoon season

Family		Name of Birds	
1	Corvidae	1 2	House Crow Rufous Treepie
2	Passeridae	1	House Sparrow
3	Sturnidae	1 2	Common Myna Asian Pied Starling
4	Pycnonotidae	1	Red Whiskered Bulbul
5	Muscicapidae	1	Oriental Magpie Robin
6	Cisticolidae	1	Common Tailorbird
7	Nectariniidae	1	Purple Sunbird
8	Dicruridae	1	Black Drongo
9	Columbidae	1 2	Yellow-footed Green Pigeon Spotted Dove
10	Ciconiidae	1	Asian Openbill Stork
11	Ardeidae	1 2	Indian Pond Heron Cattle Egret
12	Accipitridae	1	Black Kite
13	Rallidae	1	White Breasted Waterhen
14	Cuculidae	1	Greater Coucal
15	Meropidae	1	Green Bee-eater
16	Picidae	1	Lesser Golden back Woodpecker
17	Phalacrocoracidae	1	Little Cormorant
18	Jacanidae	1	Bronze-winged Jacana
19	Megalaimidae	1	Coppersmith Barbet
20	Alcedinidae	1	White Throated Kingfisher
21	Psittacidae	1	Rose-Ringed Parakeet

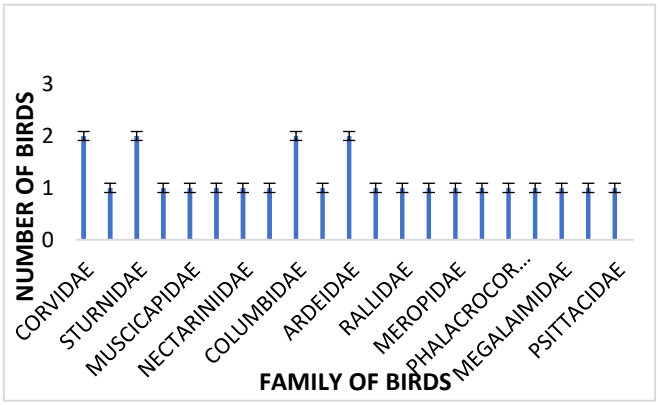

Figure 2. Showing distribution of birds according to their family in premonsoon season.

Table 4. Classification of birds of pre– monsoon season according to food habit [12].

Food Habit		Name of Birds
1	Omnivorous	House Crow Rufous Treepie Common Myna Asian Pied Starling Red Whiskered Bulbul Black Kite White Breasted Waterhen Greater Coucal
2	Insectivorous	Common Tailorbird Black Drongo Cattle Egret Green Bee-eater

		Lesser Golden back Woodpecker Bronze-winged Jacana Oriental Magpie Robin
3	Piscivorous	Indian Pond Heron Little Cormorant White Throated Kingfisher
4	Frugivorous	Yellow-footed Green Pigeon Coppersmith Barbet Rose Ringed Parakeet
5	Granivorous	House Sparrow Spotted Dove
6	Nectarivores	Purple Sunbird
7	Molluscivorous	Asian Openbill Stork

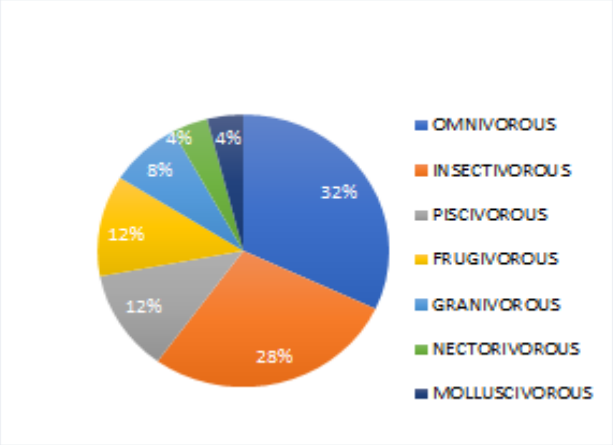

Figure 3: Showing distribution of birds according to feeding habit in premonsoon season.

Table 5. Seasonal findings of avian fauna of post - monsoon data [5].

SL.NO.	NAME OF BIRDS	NO. OF BIRDS OBSERVED			
		DAY-1	DAY-2	DAY-3	TOTAL
1	House crow	8	9	12	29
2	House sparrow	5	3	5	13
3	Common myna	8	7	6	21
4	Asian pied starling	4	5	6	15
5	Spotted dove	4	4	5	13
6	Yellow-footed green pigeon	4	3	6	13
7	Red vented bulbul	2	1	0	3
8	Black drongo	3	2	1	6
9	Oriental magpie robin	1	2	0	3
10	Little swift	2	2	3	7
11	White-throated kingfisher	1	2	2	5
12	Indian pond heron	6	2	2	10
13	Cattle egret	2	4	0	6
14	Little cormorant	1	1	3	5
15	Black kite	3	4	2	9
16	White wagtail	0	2	1	3
17	Black hooded oriole	0	1	0	1
18	Rufous treepie	1	0	0	1
19	Jungle myna	4	2	3	9
20	Purple sunbird	1	1	0	2
21	Common tailor bird	2	0	2	4
22	Green bee-eater	2	3	2	7
23	Bronze-winged jacana	2	0	2	4
24	White-breasted water hen	2	0	2	4

Table 6. Classification of observed birds according to family found in post-monsoon season.

Family		Name of Birds	
1	Corvidae	1 2	House Crow Rufous Treepie
2	Passeridae	1	House Sparrow
3	Sturnidae	1 2 3	Common Myna Asian Pied Starling Jungle Myna
4	Pycnonotidae	1	Red-Vented Bulbul
5	Muscicapidae	1	Oriental Magpie Robin
6	Cisticolidae	1	Common Tailorbird
7	Nectariniidae	1	Purple Sunbird
8	Dicruridae	1	Black Drongo
9	Columbidae	1 2	Yellow-footed Green Pigeon Spotted Dove
10	Ardeidae	1 2	Indian Pond Heron Cattle Egret
11	Accipitridae	1	Black Kite
12	Rallidae	1	White Breasted Waterhen
13	Oriolidae	1	Black Hooded Oriole
14	Meropidae	1	Green Bee-eater
15	Apodidae	1	Little Swift
16	Phalacrocoracidae	1	Little Cormorant
17	Jacanidae	1	Bronze-winged Jacana
18	Alcedinidae	1	White Throated Kingfisher
19	Motacillidae	1	White Wagtail

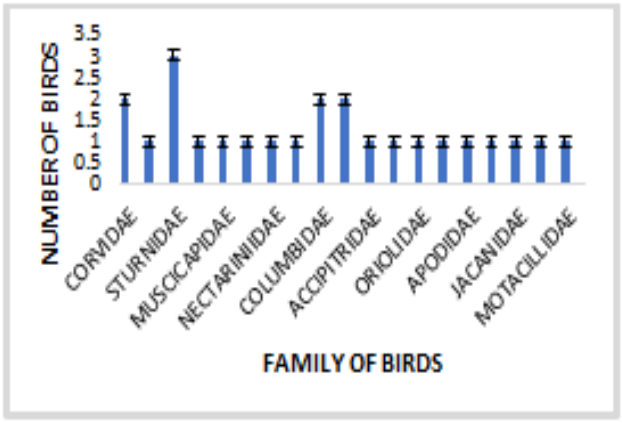

Figure 4. Showing distribution of birds according to their Family in post - monsoon season.

Table 7. Classification of birds of post– monsoon season according to food habit [12].

Food Habit		Name of Birds
1	Omnivorous	House Crow Rufous Treepie Common Myna Jungle Myna Asian Pied Starling Black Kite White Breasted Waterhen
2	Insectivorous	Common Tailorbird Black Drongo Cattle Egret Green Bee-eater White Wagtail Bronze-winged Jacana Oriental Magpie Robin Little Swift
3	Piscivorous	Indian Pond Heron Little Cormorant White Throated Kingfisher
4	Frugivorous	Yellow-footed Green Pigeon Black hooded Oriole Red Vented Bulbul
5	Granivorous	House Sparrow Spotted Dove
6	Nectivorous	Purple Sunbird

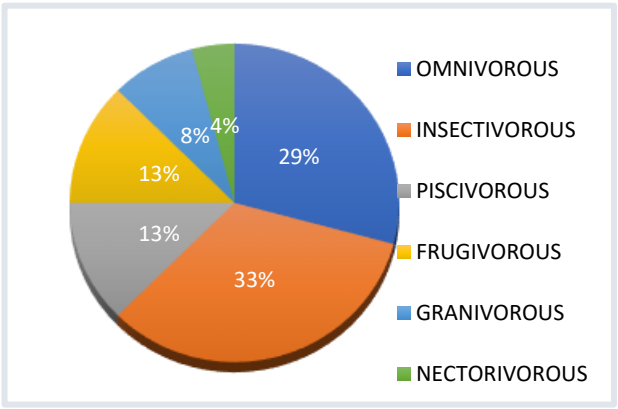

Figure 5. Showing distribution of birds according to feeding habit in post - monsoon season.

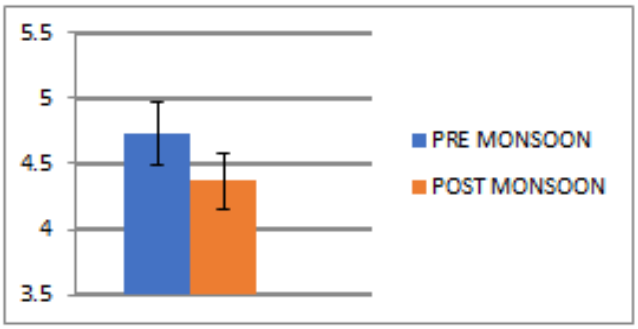

Figure 6. Showing Menhinick's Species Richness Index in the two seasons.

The pre - monsoon and post - monsoon value of Menhinick's Species Richness Index is 1.98 and 1.727 respectively. There is no such significant deviation in two seasonal diversity forms. The richness of common birds remains same throughout the year.

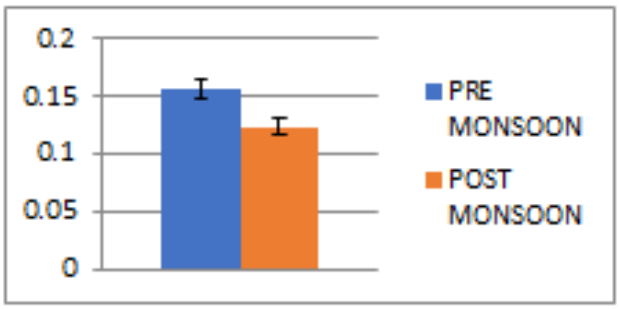

Figure 7. Showing Margalef's Species Richness Index for two seasons.

The pre - monsoon and post - monsoon value of Margalef's Species Richness Index is 4.73 and 4.37 respectively which indicate that both seasons are capable to support same diversity levels.

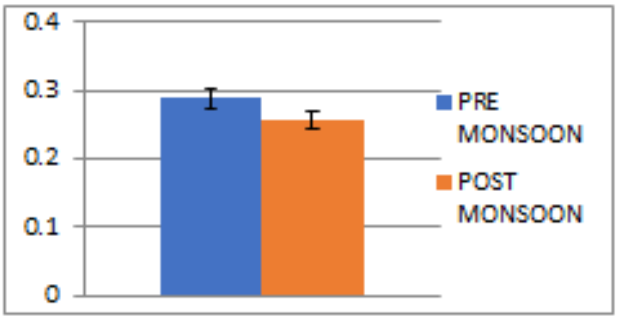

Figure 8. Showing Dominance Diversity Index for two seasons.

The pre - monsoon and post - monsoon value of Dominance diversity Index is 0.156 and 0.124 respectively. Pre - monsoon dominance diversity value is slightly greater that post - monsoon data which also indicate that species abundance is also slightly greater in pre - monsoon.

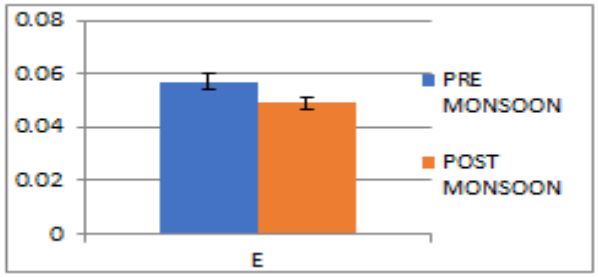

Figure 9. Showing Shannon Wiener Index for two seasons.

The pre - monsoon and post - monsoon value of Shannon Wiener Index is 0.289 and 0.258 respectively. There is no such significant deviation in two values which indicate that both seasons maintain the more or less similar diversity evenness and richness.

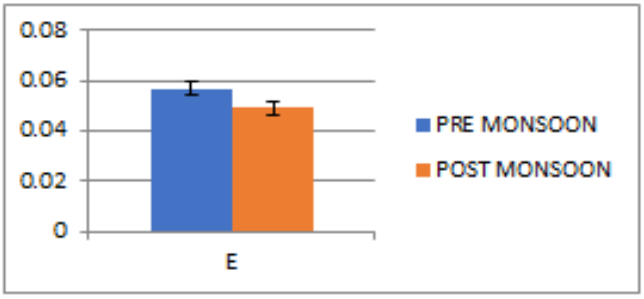

Figure 10. Showing Pielou's Species Evenness Index for two seasons.

There is also no significance change of Pielou's Species Evenness index for pre - monsoon and post - monsoon data which indicate that the species is evenly available in both seasons or throughout the year.

Discussion

Sarsuna Satellite Township is an area which has undergone change over two decades at a very high rate. It has become an urban locality from farm fields. Thus, we can directly say that there were fewer trees from the time of farm lands but allogeneic succession has taken place.

According to our field study, the pre-monsoon data and the post-monsoon data were almost the same. In the pre-monsoon season, the percentage of birds were omnivorous (32%), insectivorous (28%), piscivorous (12%), frugivorous (12%), granivorous (8%), nectivorous (4%), and molluscivorous (4%). Again, in the post-monsoon season, the percentage of birds according their food habits were omnivorous (29%), insectivorous (33%), piscivorous (13%), frugivorous (13%), granivorous (8%), nectivorous (4%). As we can see, there is no such significant variation obtained from the pre-monsoon data and post-monsoon data because no migratory birds are found in the winter season and all are common residential birds found in the semi-urbanized localities. As there are 3 lakes present in that area, we can find some common water birds too.

From the given checklists of birds during pre-monsoon and post-monsoon study; it is clear that although there is a same diversity status of birds according to family or food habits to an extent and there is no significant deviation in both seasons. As our diversity indices analysis indicates that different diversity indices show us a common picture of evenness and distribution for both seasons [19].

IV. CONCLUSIONS AND FUTURE SCOPE

Due to the presence of small ponds and lakes, local populations of birds like Indian pond heron, white-breasted kingfisher, and little cormorant are commonly found. The trees provide fruits, nectar to the birds and the grass nearby the water bodies provides a habitat to damselflies, dragonflies and butterflies. Due to the presence of trees, grass, and also the shops and houses in the locality, grains are also available in the open areas which allows the granivorous birds like house sparrow and spotted dove to stay in the locality [18].

After monsoon the insect population rises which increases the insectivorous bird population. After rain the trees blossom and the insects help in pollination resulting in fruits. Post-monsoon increase of fruits in trees and shrubs mentions high rise in frugivorous bird population.

But an adverse effect is also seen on the water bodies after monsoon because overflowing of ponds and lakes brings sewages from the drains nearby which pollutes the water heavily. Again, all the religious festivals in autumn donate a very large amount of bio-waste to the water bodies. The idols when submerged in the water bodies pollute the water and the pH of the water bodies' change due to the chemicals in paints of the idols. This leads to lowering of fish population and finally leading to some decrease in piscivorous bird population, although the species of birds having this type of food habit remain the same.

After the study of different diversity indices, we can also conclude that the species richness, species dominance and abundance are more or less similar in both pre monsoon and post monsoon days, which indicate no seasonal variations of that Sarsuna satellite township area and species diversity level also similar.

Sarsuna Satellite Township never had such wetlands [15] [20], large water bodies, swamps, dense vegetation etc. and so the area has never attracted the migratory birds to visit the place. Now there are less bare lands. Housing construction, roads and a lot of noises everywhere which also create an isolation of migratory birds from the area. So, no migratory birds are found in our study periods. From our study we have understood how anthropogenic disturbances created the succession and how it affects the bird population [9]. So, we can say that the migratory birds will never be seen in the area but the local bird population can be increased and avifaunal diversity can be enhanced by taking some sustainable measures for conservation of that Sarsuna satellite township area.

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